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Investigating the Dimensionality of Young's Internet Addiction Test for University Students Using Mokken Scale Analysis

Young İnternet Bağımlılığı Testinin Boyutluluğunun Üniversite Öğrencileri İçin Mokken Ölçek Analizi Kullanılarak İncelenmesi

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Abstract: The Internet Addiction Test has been used extensively by researchers to collect data from university students, However, empirical studies on the psychometric properties of this test have revealed conflicting results on the factor structure. Although the structure of Internet addiction is generally accepted as unidimensional, these contradictory results require further evidence for the unidimensional nature of the construct. Considering the existing problems regarding the factor structure of the Internet Addiction construct, the aim of this study was set as evaluating the unidimensionality of the Short Internet Addiction Test for University Students by using Mokken Scaling Analysis. The Internet Addiction Test short form was administered to 636 university students studying in Turkey in the 2020-21 academic year via an online data collection platform. The ages of the participants ranged from 20 to 65. The results revealed that the items of the Internet Addiction Test Short Form were scalable and homogeneous enough to form a separate scale. On the other hand, the results showed that the Internet Addiction Test Short Form did not have the Invariant Item Ranking feature. In addition, using the backward selection method, a seven-item form of the Internet Addiction Test Short Form, which has Invariant Item Ordering feature, is proposed. These results showed that the structure of internet addiction can be accepted as one-dimensional for Turkish university students. It is recommended to examine whether the results obtained in future studies can be generalized to different universes.

Keywords: Mokken scaling analysis, internet addiction, dimensionality, university students.

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Öz: İnternet Bağımlılığı Testi, araştırmacılar tarafından üniversite öğrencilerinden veri toplamak için yoğun bir şekilde kullanılmaktadır fakat bu testin psikometrik özellikleri üzerine yapılan görgül araştırmalar, faktör yapısı üzerinde çelişkili sonuçlar ortaya koymuştur. İnternet bağımlılığının yapısı genel olarak tek boyutlu olarak kabul edilmekle birlikte, bu çelişkili sonuçlar yapının tek boyutlu doğası için daha fazla kanıt gerektirmektedir. İnternet Bağımlılığı Testi kısa formunun faktör yapısına ilişkin mevcut problemler göz önüne alındığında, bu çalışmanın amacı Kısa İnternet Bağımlılığı Testinin Üniversite Öğrencileri için tek boyutluluğunun Mokken Ölçekleme Analizi ile değerlendirilmesidir. İnternet Bağımlılığı Testi kısa formu, bir çevrimiçi veri toplama platformu üzerinden 2020-21 öğrenim yılında Türkiye'de öğrenim gören 636 üniversite öğrencisine uygulanmıştır. Katılımcıların yaşları 20 ile 65 arasında değişmektedir. Sonuçlar, İnternet Bağımlılığı Testi Kısa Formunun maddelerinin ölçeklenebilirlik özelliğine sahip olduğunu ve ayrı bir ölçek oluşturmaya yetecek kadar homojen olduğunu ortaya koymuştur. Öte yandan sonuçlar, İnternet Bağımlılığı Testi Kısa Formunun Değişmez Madde Sıralama özelliğine sahip olmadığını göstermiştir. Ayrıca, geriye doğru seçim yöntemi kullanılarak, Değişmez Madde Sıralama özelliği taşıyan İnternet Bağımlılığı Testi Kısa Formunun yedi maddelik formu önerilmiştir. Bu sonuçlar, internet bağımlılığının yapısının Türk üniversite öğrencileri için tek boyutlu olarak kabul edilebileceğini göstermiştir. Gelecekteki yürütülecek çalışmalarda elde edilen sonuçların farklı evrenlere gelenellenebilir olup olmadığının incelenmesi önerilmektedir.

Anahtar Kelimeler: Mokkan Ölçeği, internet bağımlılığı, boyutluluk, üniversite öğrencisi

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1. INTRODUCTION

Simply expressed, internet addiction is a person's inability to regulate their internet use, which causes psychological and interpersonal problems in their family, academic, and professional lives (Davis, 2001). The construct was first operationalized by Young (1996) who identified eight diagnostic criteria for internet addiction: preoccupation with the Internet, tolerance, inability to cut back or avoid Internet usage, spending more time online than intended, negative effects in interpersonal, educational, or occupational dimensions of life, lying to hide the true amount of Internet use, and use of the Internet as an attempt to escape from problems. Based on these criteria, IAT was developed by Young. After this pioneering study, the concept of internet addiction has gained popularity and become a frequently researched topic (Xin et al., 2018).

Recent psychometric studies revealed that there is no conclusive evidence for the dimensional structure of the IAT. For instance, Faraci and colleagues (2013) analyzed the dimensionality of the Italian version of the IAT and discovered that, despite the scale's ability to be scored as a unidimensional instrument, the two-factor solution was marginally better fitted to the data. On the other hand, another study conducted with the same Italian population suggested six factors (Ferraro et al., 2006).

In a different study, the factor structure of the Chinese version of the Young Internet Addiction Test was examined and both IRT analysis and Mokken Scale Analysis (MSA) results revealed that the IAT has a unidimensional structure (Zhang & Xin, 2013). The IAT, however, has a three-dimensional structure, according to the results of another study conducted in Hong Kong using the Chinese version of the scale (Chang & Law, 2008). Similarly, Černja et al. (2019) stated that the Croatian version of IAT has a three-dimensional structure. The psychometric properties of the Turkish version of the IAT were examined by Boysan et al. (2017) for Turkish university students and it was concluded that the scale has a unidimensional structure. On the other hand, in another study, the four factor solution was proposed for the IAT when it is used with Turkish university students (Kaya et al., 2016). As can be shown, although the IAT has been commonly used by researchers, there are inconsistent findings on the dimensionality of the IAT.

Similar confusion is true for S-IAT which was developed by Pawlikowski, Altstötter-Gleich and Brand (2013). They stated that the scale consists of two dimensions, which they named "loss of control/time management" and "craving/social problems". On the other hand, Kutlu, Demir, Yasin, and Aysan (2015) stated that the Turkish version of the S-IAT was one-dimensional for university students. Despite contradictory findings reported in various cultures, no further research into the dimensional structure of S-IAT for Turkish university students has been conducted. This lack of studies can be seen as a threat to the validity of S-IAT and further studies are needed to obtain more knowledge on the dimensionality of S-IAT.

Classical Test Theory (CTT) and Item Response Theory (IRT) are two main approaches to evaluating the dimensionality of scales (IRT). Techniques such as principal component analysis and factor analysis are used, and Cronbach's alpha value is calculated to examine reliability related to the internal consistency of items of a measurement instrument in the CTT approach to analyze construct validity. The main limitation of CTT approach is that the statistics that it generates are dependent on the sample from which the data is obtained (Amin et al. 2012).

Furthermore, all items are considered to be equally related to the underlying structure, and score intervals on the scale are assumed to be equal. These assumptions, on the other hand, are difficult to meet in real-world conditions (Streiner & Norman, 2008). Therefore, according to van Schuur (2003), it is difficult to say

if the items shape a scale measuring the same definition in the sense of the CTT. The IRT approach, on the other hand, enables to obtain sample-free item-level and person-level statistics (Embretson & Reise, 2000).

Over the years, dozens of IRT models were developed by researchers to model the relationship between the latent trait and behavior of respondents (see Ostini & Nering, 2006). However, the IRT models can be divided into two broader families of models (Molenaar, 2002): parametric and non-parametric (NIRT). The most significant advantage of NIRT over parametric IRT models is that it relaxes some of the parametric models' strong assumptions (logistic ogive or sigmoid form of item characteristic curve) (Sijtsma & Molenaar, 2002). Constraints imposed by logistic or probit functions were loosened in the NIRT models. Mokken models belong to the class of NIRT and their popularity has grown over time. The MSA approach has been increasingly used for assessing the dimensionality of the scales (i.e. Thompson & Watson, 2011; Watson et al., 2012; Stochl et al., 2012).

The MSA is an extended version of the simple deterministic Guttman scaling model (Guttman, 1949) which is based on the assumption that data is error-free. Mokken models brought Guttman's idea to a probabilistic framework, and they can be applied to both dichotomous and polytomous items (Mokken, 1971) and polytomous data (Molenaar, 1982). The main advantage of MSA is the absence of parametric assumptions that describe the relationship between responses to items and the underlying latent trait. As known, this relationship is represented by an S-shaped curve in IRT parametric models (Stochl et al., 2012). This curve shows how the respondent's probability of correct answer or endorsing any points among the options changes across the ability spectrum.

On the other hand, MSA uses relatively liberal assumptions. The main assumption is that individuals can be ranked on a scale through their total score from a group of items (Sijtsma & van der Ark, 2017). MSA could be applied by researchers who develop tests to measure latent constructs (Sijtsma et al, 2008) and, who aim to investigate the psychometrical properties of existing measurement tools. Besides, with this non-parametric approach, the ordering information about the individual items can be obtained, while the item locations that correspond to ability levels cannot be obtained (Molenaar & Sijtsma, 2000). Despite this disadvantage, MSA has become very popular among researchers.

There are two different models for Mokken Scaling Analysis: monotone homogeneity model (MHM) and double monotonicity model (DMM). These models were developed by Mokken (Mokken, 1971) for the scaling of items. The DMM is a special variant of the MHM. In addition to being an ordinal person measurement model, the DMM implies the ordering of items through average item scores. This feature is also referred to as invariant item ordering (IIO; Sijtsma & Junker, 1996). The IIO implies that regardless of respondents' ability level, items could be ranked hierarchically based on their difficulties or commonality/prevalence. It is mainly used in instruments measuring intelligence, cognitive traits and academic achievement. Reviewing the literature, it was found that the number of studies conducted to investigate the psychometric properties of the measurement instruments within the MSA framework is increasing day by day (i.e. Akansel et al., 2013; Bagnasco et al., 2015; Finseras et al., 2019; Stochl et al., 2012).

Although the assumptions of parametric IRT models do not apply to MSA, some assumptions must still be met. The first assumption of MSA is unidimensionality, which means that there must be only one latent trait (denoted as θ) to explain the relationship between item scores, and that any factor other than θ should not affect the observed response patterns of individuals. The second assumption is local independence, which means that there is no relationship between the items when the effect of the latent trait is statistically controlled. The third assumption is monotonicity, which implies that Item Step Response Functions (ISRFs) have non-decreasing functions on the θ-continuum. These first three assumptions are the same for both the MHM and the DMM. In addition to the assumptions common to both models, the DMM requires the assumption that there are non-intersecting Item Response Functions (IRFs of ISRFs). It implies that ISRFs do not intersect (Sijtsma & van der Ark, 2017).

In the NIRT context, scalability coefficients are used to differentiate between low and high quality items in terms of the test score distribution. These coefficients (also referred to as homogeneity coefficients) play an

important role in the MSA. They were first introduced by Loevinger (1947) to evaluate the homogeneity of a set of items. They are regarded as a direct indication of the practical usefulness of items (Mokken, Lewis & Sijtsma, 1986). There are three different scalability coefficients available for consideration of a scale: H_i, H_{ij} and H.

The coefficient Hi is calculated for each item and gives an information about the scalability of the item. H_i coefficient can also be regarded as discrimination index. In order for an item to fit to the MHM, H_i value of this item must be between $0 \leq H_i \leq 1$. Otherwise, the item is removed from the item pool. In addition, there are Hij coefficients between each pair of items. Technically, the H_{ij} coefficient is defined as the ratio of covariance between items i and j. If these coefficients get a negative value, it indicates that at least one of the items will not fit the MHM. If an item has negative the H_{ij} coefficient values for multiple items, this item should be removed from the scale.

Thirdly, the scalability coefficient H can be obtained for the whole item set. Technically, the H coefficient is the weighted average of the H_i coefficients and this coefficient is used to evaluate the homogeneity of the scale as a whole. In addition, H coefficient is an indicator of the average discrimination power of the measurement instrument and indicates how strictly individuals can be ranked according to the total score. If H = 1, the test data follows an excellent Guttman scalogram. Mokken (1971) proposed the following general rule for the interpretation: H values between $.3 \leq H < .4$ considered weak scale; $.4 \leq H < .5$ moderate level scale; $H \geq .5$ strong scale. The terms "weak", "medium" and "strong" refers to the accuracy of the ranking of people according to their total test score. For the meaningful interpretation of these rules, standard errors of scalability coefficients should also be taken into consideration (Sijtsma & van der Ark, 2017).

In addition, there is an another coefficient that shows how accurately persons are ordered on a latent scale continuum, denoted as the H^T. It is interpreted by considering the recommended intervals for the H coefficient. This coefficient value is related to IIO and it gives information about the level of IIO of the given item set.

MSA also offers an automated item selection procedure (AISP) for creating unidimensional scales by selecting items from a pool. To put it more precisely, the AISP identifies sub-group(s) of items and deviating items and form homogeneous subsets. Deviating items are regarded as poor and not scalable, which do not belong to any scale. So they do not take place on any sub-group. It is an exploratory method for a set of items on a Mokken scale implied by the monotonous homogeneity model with reasonable discrimination power. In this process, scalability coefficients of items are used when creating clusters (Sijtsma & Molenaar, 2002, p. 67-69). These clusters include the items forming homogeneous subsets of items. Even there are some other methods, unidimensionality and homogeneity of items can also be investigated with the MSA. Basically, MSA is used to evaluate whether each item measures the same underlying trait.

1.1. Aim of the study

The objectives of this study are as follows: i) examining the structural validity of S-IAT by using MSA; ii) investigating of the hierarchy of the item and whether S-IAT has the property of the IIO.

1.2. The importance of the study

The findings of the current study are important for a couple of aspects. First of all, considering the existing confusion regarding the factor structure of S-IAT, the findings will contribute to the understanding of the construct validity of the S-IAT. In addition, apart from unidimensionality, some other properties, like the

IIO, was investigated. Further, IRT based approach was used for the first time for the analysis of S-IAT items.

2. METHOD

2.1. Research design

This study, which aimed to investigate the dimensional structure of S-IAT for university students, was conducted based on descriptive research design. In descriptive research designs, the researcher does not exert any manipulation on the variables and on the participants of the research. The main purpose is to describe the phenomenon under consideration is the most accurate and systematic way and present its basic characteristics (Glass & Hopkins, 1984). In addition, this study could be regarded as a validation study because the dimensional structure of internet addiction is at the center of the current study.

2.2. Participants

This research was conducted in a major metropolitan city in Turkey. The data was collected via an online data collection platform due to the 2020 pandemic outbreak. Participants were selected from four different universities and they consisted of 636 university students. While women constituted 79.4% of the total participants (n=505), men constituted 20.6% (n=131). In addition, the ages of the participants varied between 20 and 65 (Mean = 21.79, SD = 3.94).

2.3. Data collection tools

In this study, Short-Internet Addiction Test (S-IAT) was used to determine the levels of internet addiction of the participants. It is the shorter version of Young's (1998) the test and was developed by Pawlikowski, Altstötter-Gleich and Brand (2013). S-IAT consists of 12 items measuring internet addiction. The items are scored with 5-point Likert type response format. The test was adapted to Turkish by Kutlu et al. (2016). During the adaptation process, exploratory factor analysis showed that the first factor explains %39.5 of total variance for university students and one factor solution was regarded as the best solution. In addition, unidimensionality was supported with further confirmatory factor analysis. The possible score range of S-IAT ranges between 12 to 60 and the higher scores are regarded as a sign of internet addiction.

2.4. Data analysis

Data were scrutinized for potential missing or unacceptable values but no susceptible values were detected. After the completing the data check, the analyzes were carried out using the “mokken” (version of 2.8.11) package (van der Ark, 2007) which is available in the R 4.0.0 statistical program (R Core Team, 2019). H_i, H_{ij} and H coefficients were calculated by using the "*check.ca*" command to evaluate the homogeneity of the data set. Then, the "*check.monotonicity*" command was used to examine the monotonicity assumption of the items. While performing this analysis, suggested default minvi and minsize values were not altered. Conditional association index (Sijtsma et al., 2015) was used to check local independence assumption. AISP procedure was conducted with conventional approach (Sijtsma & Molenaar, 2002) and recently proposed genetic algorithm (Straat, van der Ark & Sijtsma, 2013). In addition, the IIO was investigated by using Manifest Invariant Item Ordering (MIIO) method which was proposed by Ligtvoet, Van der Ark, Te Marvelde and Sijtsma (2010). Finally, as an indirect indication of homogeneity of items, reliability coefficients were calculated.

2.5. Ethical approval

In this study, all rules stated to be followed within the scope of the “Higher Education Institutions Scientific Research and Publication Ethics Directive” were followed. None of the actions specified under the title of “Actions Violating Scientific Research and Publication Ethics,” which is the second part of the directive, have not been carried out gerçekleştirilmemiştir.

Ethics Committee Approval Information:

Ethical committee = Marmara University, Institute of Educational Sciences, Research and Publication Ethics Committee

Data of ethical approval= 19.11.2020

The number of ethical approvals=2000310198

3. FINDINGS

3.1. Scalability of S-IAT items

Both MHM and DHM assume the unidimensionality of item set. Accordingly, the S-IAT item set was tested whether the 12 S-IAT items measure a single underlying structure. For this aim, Loevinger's scalability coefficients (H, H_i and H_{ij}) were calculated. The estimated values were given in Table 1. The H_i values for each item in the table are higher than 0.5 although after taking standard errors bounds into account. These values are well above the 0.3 threshold value and suggest that 12 S-IAT items are sufficiently homogenous, highly related to each other and form a strong scale (Sijtsma & Ark, 2017). In addition, the H coefficient was found to be 0.57. This value is also sufficient to regard 12 S-IAT items as homogenous and measuring the same underlying trait.

Table 1.
Scalability coefficients for S-IAT

	i1	**i2**	**i3**	**i4**	**i5**	**i6**	**i7**	**i8**	**i9**	**i10**	**i11**	**i12**
H_{ij}												
		0.60	0.57	0.60	0.58	0.53	0.55	0.56	0.58	0.63	0.58	0.54
i1	-	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
			0.52	0.48	0.60	0.49	0.54	0.50	0.57	0.58	0.53	0.47
i2		-	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
				0.51	0.55	0.51	0.51	0.51	0.51	0.54	0.57	0.53
i3			-	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
					0.59	0.56	0.55	0.53	0.56	0.56	0.58	0.54
i4				-	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
						0.60	0.55	0.57	0.57	0.61	0.57	0.54
i5					-	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
							0.61	0.59	0.58	0.58	0.59	0.57
i6						-	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
								0.59	0.65	0.66	0.64	0.57
i7							-	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
									0.62	0.63	0.59	0.55
i8								-	(0.03)	(0.03)	(0.03)	(0.03)
										0.67	0.62	0.60
i9									-	(0.03)	(0.03)	(0.03)
											0.62	0.59
i10										-	(0.03)	(0.03)
												0.59
i11											-	(0.03)
i12												
H_i												
	0.57	0.54	0.53	0.55	0.57	0.56	0.58	0.57	0.60	0.61	0.59	0.55
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
H												

	0.57
	(0.02)

Note: Standard error values are given in parentheses

3.2. Assessing monotonicity

Another assumption of MHM and DHM is monotonicity. This assumption is related to the fact that the item characteristic curves were monotonously increasing across the latent trait continuum and it is a prerequisite for accurate ordering of the participants according to their total scores. Results for evaluating monotonicity were provided in Table 2. The values in the #vi column show the number of violations that were made, and the values in the crit column showed how many of these violations are at a critical level. Finally, #zsig values give information about whether this critical number is significant or not. Accordingly, when the values in the table were analyzed, it was seen that the critical violations observed for items 4 and 12 were statistically significant. In other words, ISRFs of these items did not increase monotonously and showed considerable declines at some point in latent trait continuum. This implies that these items had less power to discriminate between persons with high and low levels of internet addiction.

Another approach that can be used to examine monotonicity is to examine ISRF graphs. To ensure monotonicity, curves must have non-decreasing form at any point in latent trait continuum. The amount of decrease that will be regarded as acceptable as is determined by minvi value in R program. The graphs of S-IAT items were given in Figure 1. As it is seen, although there are irregularities in the increase of ISRFs for all of the items, these irregularities are more clear especially for items 4th and 12th. Although non-decreasing functions could be observed for the other items, they are not salient as the ones observed for item 4th and item 12th.

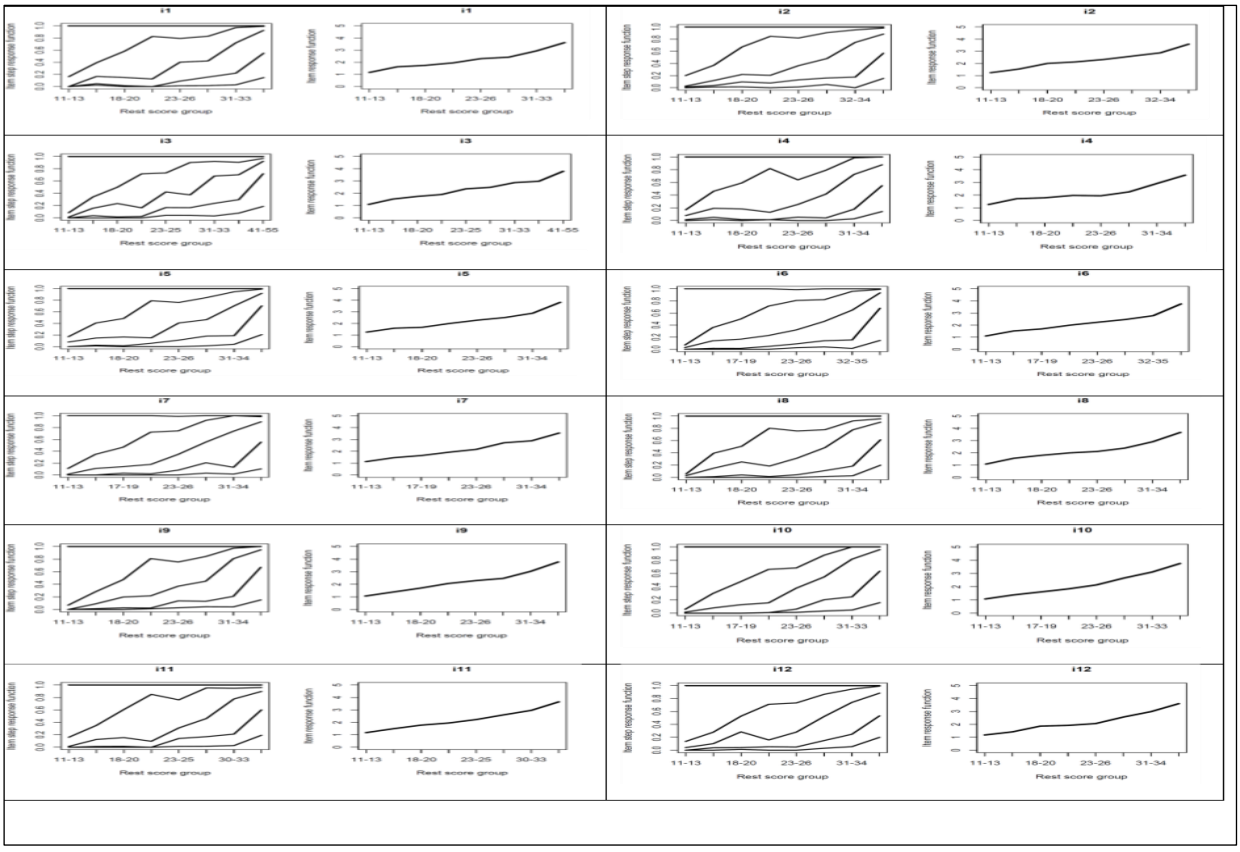

Figure 1. Monotonicity plots of S-IAT items

Molenaar and Sijtsma (2000) suggested that the monotonicity assumption is not seriously violated for items whose crit statistics fall below 40, and therefore these items could be kept on the Mokken scale. However,

if the violation is serious (> 40), the proposed strategy is to remove an item with the highest critical value and then to repeat the analysis again. The item removal continues until no item is left with a critical value higher than 40. In addition, if more than half of the available items is eliminated during this process, these removed items could also be examined by a similar process within the MSA framework as a different item set. In this way, it was scrutinized whether removed items can form a second scale. In this regard, due to the fact that item 4 has more than 40 critical violations and the critical violations are significant, IIO analysis was repeated by removing this item from the S-IAT item.

Table 2.
Output for assessment of monotonicity

Item #	#ac	#vi	#zsig	crit
i1	78	4	0	11
i2	100	1	0	4
i3	110	2	0	7
i4	88	5	1	46
i5	86	1	0	-6
i6	87	0	0	0
i7	72	1	0	4
i8	80	2	0	6
i9	73	1	0	-1
i10	63	0	0	0
i11	79	2	0	9
i12	85	1	1	26

The analyzes were repeated after the 4th item was removed. The results of this analysis were presented in Table 3. As a result of these analyzes, it was decided to remove 12th item because the violations were found to be significant again. After removing this item, the analysis of ten S-IAT items was repeated and it was found that no significant violations were observed for the remaining items. It could be suggested that these ten items can meet the monotonicity assumption.

Table 3.
Output for assessment of monotonicity with 10 items s-YIAT

Item#	#ac	#vi	#zsig	crit
i1	82	3	0	10
i2	93	0	0	0
i3	87	4	0	23
i5	104	0	0	0
i6	85	0	0	0
i7	84	0	0	0
i8	79	2	0	4
i9	68	2	0	4
i10	69	1	0	4
i11	90	2	0	-3

3.3. Assessing local independence

Another assumption for MHM and DHM is the local independence of items. The indices of W1 and W3 (Straat et al., 2016) were used to examine the local independence of S-IAT items. The higher W1 values indicate positive local dependence while W3 index negative local dependence of the corresponding items. At the decision phase Tukey's fence test was applied, and significant items were flagged as locally dependent. Detailed results were not presented because of the large amount of output obtained for this analysis. As a result of the investigation of these output, it was observed that none of the IAT items was flagged for being locally dependent.

3.4. Assessing invariant item ordering

As stated previously, non-intersection and the IIO are two main assumptions only for DMMs. Although scale items do not meet these assumptions, an additional process could be applied to select a homogeneous subset of items and create a scale with IIO. An iterative approach was used until no violation of IIO remained, and the property of IIO was evaluated with H^T coefficient at each stage. The number of significant violation values was given in Table 4 (presented in #tsig column). Accordingly, item 10 is the one with the most significant violation. In addition, significant violations were observed for other items, except for item one.

The HT coefficient was also calculated in this process. It provides information on the extent to which the respondents ranked the items invariantly (Sijtsma & Meijer, 1992). The results suggest that the IIO assumption was not met (H^T= -0.001). The value was lower than the 0.03 threshold recommended by Ligtvoet et al. (2010). Accordingly, IRFs are very close to each other, and therefore it is difficult to distinguish one item from one another.

Table 4.
Output for assessment of invariant item ordering

#Item	#ac	#vi	#tsig	crit
i2	62	8	4	107
i11	61	2	1	47
i5	62	4	1	60
i1	62	4	0	47
i9	63	4	2	64
i10	63	12	7	141
i8	63	9	5	123
i6	61	6	1	78
i7	62	6	2	82
i3	63	7	1	88

The Critical values (shown in the crit column in Table 4) could be used to eliminate items that violate IIO using the backward selection method. In this way, a subgroup of items meeting the IIO assumption could be obtained. If there are an equal number of violations for two or more items, it was suggested that the item with the lowest scalability could be removed (Ligtvoet, van der Ark, te Marvelde & Sijtsma, 2010). After the worst item (item with the highest critical value) is removed, it is checked again whether the remaining items have IIO property (similar to the procedure used for the investigation of monotonicity). This item removal process continues until critical values drop below 40 and the number of significant violations becomes zero for each item. By adopting the above-outlined procedure. The results of this analysis for the remaining ten S-IAT items set are shown in Table 5.

The values in the table show number of significant violations per item and the NAs represent that the item was removed. Accordingly, item 10 was removed in the second step and item 8 was removed in the third step, and this process continued until a set of items without critical violation remained. At the end of this process, three items (items 10, 8 and 7) were removed, and the final dataset was obtained. As summarized in Table 5, the remaining seven items do not show any critical violations and have the property of IIO and have AISP property (shown in the far left column in the table).

Table 4.
Backward stepwise removal of s-YIAT items violating IIO

#Items	1	step 2	step 3	step 4
i2	3	2	1	0
i11	1	0	0	0
i5	1	0	0	0
i1	0	0	0	0
i9	2	2	1	0
i10	5	NA	NA	NA
i8	4	3	NA	NA
i6	1	0	0	0
i7	2	2	2	NA
i3	1	1	0	0

3.4. Assessing invariant item ordering

The reliability of 12 S-IAT items was checked with Cronbach's alpha, Guttman's Lambda 2 and latent class reliability coefficient (Van der Ark, Van der Palm & Sijtsma, 2011). The estimated values for these coefficients were found to be 0.937, 0.938 and 0.937 respectively. These results also support the homogeneity of S-IAT items.

4. DISCUSSION and RESULTS

The aim of this study was to examine the psychometric properties of S-IAT with MSA. The findings obtained in this study showed that s-IAT could be used as a unidimensional measurement tool. Findings revealed that the H coefficient was found to be 0.57 and it was concluded that the S-IAT items have a scalability property and homogeneous. These findings supported the unidimensionality of the S-IAT for Turkish University Students. In addition, the finding related to the homogeneity of S-IAT items is in line with the findings obtained from a previous study (Zhang & Xin, 2013) which reported the H value as 0.35.

The results suggested that the discrimination levels of the two items of S-IAT were low and the ability to distinguish between individuals with and without Internet addiction was insufficient. Interestingly, these two items were among the three items with the lowest factor loadings in the validity and reliability study conducted by Kutlu, Demir and Aysan (2016). In other words, these two items are not central to the latent trait that they intend to measure and the amount of information they provide is relatively lower. For this reason, the option of revising these two items or removing them from the measuring tool can be considered in future studies. Since the aim of this study was not to obtain a shorter version of S-IAT, the readers should not consider this finding as a strict recommendation because some other concerns like the content validity of the scale need to be taken seriously when eliminating items. Detailed investigation of the content of these items is out of the scope of the current study.

On the other hand, it was seen that the twelve item version of S-IAT does not have IIO feature. By using a backward removal process, our Mokken scaling analysis confirmed that the property of IIO could be achieved with seven items version of S-IAT. Such a scale meets the powerful Mokken double monotonicity model which is the ultimate goal of the nonparametric IRT analysis performed here. As previously stated, the main aim of the current study was to test the homogeneity of S-IAT for the population of university students. Although seven item version of s-IAT with IIO was proposed, it should not be forgotten that item removal is not a process that can be performed solely based on psychometric inquiry. Especially, the opinions of field experts and the content of those items need to be taken into account. Hence, seven item version of the S-IAT should not be used without further investigation. In addition, each item of the scales like a-IAT corresponds to a symptom of a psychological disorder. For this reason, removing an item also causes missing the chance of measuring a symptom of a disorder. In addition, IIO is a desirable feature, especially for intelligence, cognitive, and achievement tests where correct-incorrect response categories are used because responding items with invariant difficulty increase the validity and fairness of tests. Then, the measurement tools provide more sound test scores. On the other hand, the difficulty of items is not necessarily crucial for the instruments measuring psychological traits that true-false answer format is not used. For this reason, a psychological test with IIO property may not be a high priority when constructing a test.

All in all, this study was the first one to examine the psychometric properties of S-IAT with the MSA. We suggest using parametric IRT methods in the future studies. In this way, new insights could be gained for the measurement and structural validity of internet addiction construct. In addition, the findings of the current study provided support for the unidimensionality and validity of internet addiction construct when it is used with university students.

In this study, the high ratio of female participants may affect the results. In future studies, it is recommended to use datasets with a more balanced gender distribution. Similarly, the findings obtained in this study are based only on the data obtained from the self-report scales. This made the study fragile to the problems that would adversely affect the measurement results, such as recall bias or social desirability bias. Finally, one of the important reasons for using NIRT is that it allows for more items to be preserved on a final scale compared to parametric approaches. In future studies, it would be worthwhile to investigate whether NIRT models are more parsimonious than parametric IRT models in terms of item removal.

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GENİŞLETİLMİŞ ÖZET

1. GİRİŞ

İlk defa Young tarafından tanımlanan İnternet Bağımlılığı kavramını ölçmeye geliştirilen ilk ölçüm aracı olan Young Internet Bağımlılığı Testi (YİBT) sonraki yıllarda konunun popüler olması ile birlikte araştırmacılar tarafından yoğun olarak kullanılmaya başlanmıştır. Bununla birlikte YİBT'nin boyutluluk yapısına dair net açıklamalar gerektiren bazı sorunlar mevcuttur. Açıkçası, YİBT'nin psikometrik özellikleri üzerine yapılan araştırmalar, boyutluluk yapısına dair çelişkili sonuçlar vermiştir.

Örneğin, ölçeğin İtalyanca versiyonunun faktöriyel yapısı Faraci, Craparo, Messina ve Severino (2013) tarafından incelenmiş ve iki faktörlü çözümü önermiştir. Başka bir çalışmada, Çince versiyonunun faktör yapısı incelenmiş ve hem Madde Tepki Kuramına dayalı analizler hem de Mokken Ölçekleme Analizi, YİBT'nin tek boyutlu bir yapıya sahip olduğunu ortaya çıkarmıştır (Zhang & Xin, 2013). Öte yandan, ölçeğin Çince versiyonu ile Hong Kong'da yapılan başka bir çalışmada YİBT'nin üç boyutlu bir yapıya sahip olduğu sonucuna varılmıştır (Chang & Law, 2008). Benzer şekilde Černja, Vejmelka ve Rajter (2019), YİBT'nin Hırvatça versiyonunun üç boyutlu bir yapıya sahip olduğunu belirtmiştir. BİBT'nin Türkçe versiyonunun psikometrik özellikleri Boysan ve arkadaşları tarafından (2017) incelemiş ve ölçeğin tek boyutlu bir yapıya sahip olduğu belirtilmiştir.

Benzer belirsizlikler, Pawlikowski, Altstötter-Gleich ve Brand (2013) tarafından geliştirilen YİBT'nin kısa versiyonu (K-YİBT) için de geçerlidir. Ölçeğin orijinal versiyonunun "kontrol kaybı / zaman yönetimi" ve "aşerme / sosyal sorunlar" olmak üzere iki boyuttan oluştuğu belirtilmiş olmasına rağmen Kutlu, Demir ve Yasin ve Aysan (2015) tarafından uyarlanmış Türkçe versiyonu için tek boyutlu bir yapıya sahip olduğu bildirilmiştir ve ülkemizde gerçekleştirilen çalışmalarda ölçeğin tek boyutlu olduğu kabulüne dayalı olarak puanlama gerçekleştirilmektedir. Bu sonuçlara dayalı olarak, ölçeğin tek boyutlu bir yapı gösterip göstermediğini belirlemeye yönelik alternatif yaklaşımlara dayalı olarak daha fazla araştırma yürütülmesi gerektiği düşünülmektedir. K-YİBT'nin faktör yapısı ile ilgili mevcut tutarsız alan yazın göz önüne alındığında, bu çalışmanın amacı K-YİBT 'nin boyutsal yapısının yoğun olarak çalışmaların yürütüldüğü Türk üniversite öğrencileri için homojen bir yapıya sahip olup olmadığının ve tek boyutlu olarak değerlendirilip değerlendirilemeyeceğinin incelenmesidir.

2. YÖNTEM

Betimleyici araştırma deseni kullanılarak gerçekleştirilen bu çalışmanın verileri Türkiye'nin önemli bir metropol şehrinde öğrenim gören öğrencilerden toplanmıştır. Nihai örneklem grubu 636 üniversite öğrencisinden oluşmuştur. Katılımcıların 505'i (% 79,4) kadın ve 131'i (%20,6) erkektir. Ayrıca katılımcıların yaşları 20 ile 65 arasında değişmektedir (Ort. = 21.79, SS = 3.94). Katılımcıların internet bağımlılık düzeylerini belirlemek için Pawlikowski, Altstötter-Gleich ve Brand (2013) tarafından geliştirilen Kısa İnternet Bağımlılığı Testi (K-İBT) kullanıldı. Young'ın (1998) İnternet Bağımlılığı Testinin kısa versiyonu olan K-İBT, internet bağımlılığını ölçmeye yönelik 12 maddeden oluşmaktadır. Analizler, R istatistik programında (R Core Team, 2019) yer alan "mokken" paketi (van der Ark, 2007) kullanılarak gerçekleştirilmiştir. K-İBT maddelerinin homojenliğini değerlendirmek için Hi, Hij ve H katsayıları, hesaplanmıştır. Yerel bağımsızlık varsayımını kontrol etmek için koşullu ilişkilendirme indeksi (Sijtsma, Van der Ark & Straat, 2015) kullanılmıştır. Otomatik Madde Seçimi için Sijtsma ve Molenaar (2002) tarafından önerilen geleneksel yaklaşımla ve yakın zamanda Straat, van der Ark ve Sijtsma (2013) tarafından önerilen genetik algoritma kullanılmıştır. Son olarak değişmeyen madde sıralamasının incelenmesi için, Ligtvoet, Van der Ark, Te Marvelde & Sijtsma (2010) tarafından önerilen Açık (Manifest) Değişmeyen Madde Sırası yöntemi kullanılmıştır.

3. BULGULAR, TARTIŞMA ve SONUÇ

Hesaplanan ölçeklenebilirlik katsayıları 12 K-İBT maddesinin yeterince homojen, birbiriyle yüksek oranda ilişkili olduğunu ve güçlü bir ölçek oluşturduğunu göstermektedir. Özellikle H katsayısı için hesaplanan

0.57 değeri K-IBT maddelerini homojen olarak kabul etmek ve onların aynı temel özelliği ölçtüğünü kabul etmek için yeterlidir. Diğer taraftan, K-IBT maddelerinin tekdüzelik varsayımını taşıyıp taşımadığı incelenmiş ve özellikle 4. ve 12. maddeler için gözlenen kritik ihlallerin önemli olduğu görülmüştür. Aynı zamanda tekdüzelik varsayımının değerlendirilmesi amacıyla tekdüzelik grafikleri incelenmiş ve benzer şekilde 4. ve 12. maddeler için gözlenen kritik ihlallerin önemli olduğu sonucuna ulaşılmıştır. Daha sonrasında Molenaar ve Sijtsma (2000) tarafından belirtildiği şekilde kritik ihlal sayısı 40'ın altına düşene kadar iki aşamada sırasıyla 4. ve 12. maddeler elenmiş ve 10 maddelik tekdüzelik özelliğine sahip alternatif bir madde alt seti elde edilmiştir. Bir diğer varsayım olan yerel bağımsızlığın incelenmesi için W1 ve W3 katsayıları hesaplanmış ve maddelerin yerel bağımsızlık varsayımını ihlal etmedikleri belirlenmiştir. K-İBT ölçeğinin maddelerinin değişmeyen madde sırası özelliğine sahip olup olmadığını değerlendirmek için ise HT katsayısı hesaplanmış ve geriye doğru seçim yöntemi ile 4. ve 12. maddelerin elendiği ve 7 maddelik alt madde setinin değişmeyen madde sırası özelliğini taşıdığı belirlenmiştir. Son olarak, 12 K-IBT'nin güvenilirliğini belirlemek için Cronbach's alpha, Guttman'ın Lambda 2 ve gizli sınıf güvenilirlik katsayıları (Van der Ark, Van der Palm & Sijtsma, 2011) hesaplanmıştır. Bu katsayılar için kestirilen değerler sırasıyla 0,937, 0,938 ve 0,937 olarak bulunmuştur.

Bulgular, K-IBT maddelerinin iyi düzeyde ölçeklenebilirlik özelliğine sahip olduğuna ve homojen bir yapı gösterdiğine işaret etmektedir. Elde edilen bu bulgu internet bağımlılığı yapısının üniversite öğrencileri için tek boyutlu bir yapı olduğunu doğrulamaktadır. Elde edilen bulgular, K-İBT'nin iki maddesinin (4. ve 12. Maddeler) ayrımcılık düzeylerinin düşük olduğunu ve internet bağımlılığı olan ve olmayan bireyleri ayırt etme becerisinin yetersiz olduğunu ortaya koymuştur. Bu iki madde, ölçmeyi amaçladıkları gizil özellik açısından merkezi konumda değildirler ve K-İBT maddelerinin homojenliğini bozmaktadırlar. Aynı zamanda, uygulayıcılara sağladıkları bilgi miktarı nispeten daha düşüktür.

Elde edilen bulgular İnternet Bağımlılığı yapısının Türk üniversite öğrencileri için tek boyutlu bir yapıya sahip olduğunu desteklemektedir. Araştırmacılar üniversite öğrencileri ile gerçekleştirecekleri çalışmalarda ilgili alan yazındaki boyutluluğa dair çelişkiyi bu doğrultuda değerlendirebilirler. Diğer taraftan, özellikle parametrik madde tepki kuramı modellerinden yararlanılarak K-İBT'nin tek boyutluluğuna dair yeni çalışmalar yapılması önerilmektedir. Ayrıca, gerçekleştirilen bu çalışmada örneklem grubu cinsiyet dağılımı açısından dengesizdir. Bu sebeple araştırmacılar elde edilen bulguları bu doğrultuda yorumlamalı ve dikkatli olmalıdır. Ayrıca, bundan sonra gerçekleştirilecek olan çalışmalarda, K-İBT'nin boyutluluğunun farklı örneklem grupları için de değerlendirilmesi önerilmektedir.

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